CLAIMS

What is Claimed is:

1. Method of making films surface imprinted with nanometer-sized particles to produce micro- and/or nano-structured electron and hole collecting interfaces, comprising:

providing at least one transparent substrate;

providing at least one photoabsorbing conjugated polymer;

providing a sufficient amount of nanometer-sized particles to produce a charge separation interface;

providing at least one transparent polymerizable layer including a sol-gel or monomer;

embedding said nanometer-sized particles in said conjugated polymer;

applying said polymerizable layer on a first said substrate to form a charge transport film layer;

applying said conjugated polymer/nanometer-sized particle mixture on a second said substrate to form a nanometer-sized particles bearing surface film layer, wherein said nanometer-sized particles form a stamp surface;

imprinting said stamp surface into the surface of said polymerizable film layer to produce micro- and/or nano-structured electron and hole collecting interfaces;

polymerizing said polymerizable film layer to promote shrinkage to form a conformal gap between said stamp surface and said surface of said polymerizable film layer; and

filling said gap with at least one photoabsorbing material to promote the generation of photoexcited electrons and transport to the charge separation interface.

2. The method according to claim 1, wherein either said applying further comprises at least one of processes of spin-coating, dip-coating, spray-coating, flow-coating, doctor blade coating, and screen-printing.

3. The method according to claim 1, wherein said imprinting includes compressing and thereafter, solidifying said stamp surface into said surface of said polymerizable layer.

4. The method according to claim 1, wherein said nanometer-sized particles having average particle sizes of about 1 nm to about 100 nm in diameter and up to about 1 nm to about 1 cm in length.

5. The method according to claim 4, wherein said nanometer-sized particles having average particle sizes of about 1 nm to about 100 nm in diameter and up to about 1 nm to about 500 nm in length.

6. The method according to claim 1, wherein said nanometer-sized particles further comprises at least one of SWNT, and nanocrystals of semiconductor materials.

7. The method according to claim 6, wherein said nanocrystals of semiconductor materials comprises at least one of CdSe, metal nanowires, and metal-filled carbon nanotubes.

8. The method according to claim 1, wherein applying said polymerizable film layer ranging in thickness from about 1 nm to about 1 mm.

9. The method according to claim 1, wherein applying said conjugated polymer mixture ranging in thickness from up to about 100 nm.

10. The method according to claim 1, wherein said polymerizable layer comprises at least one monomer.

11. The method according to claim 1, wherein said polymerizable layer comprises at least one sol-gel.

12. The method according to claim 1, wherein said polymerizable layer includes nanometer-sized particles electrophoretically deposited.

13. The method according to claim 12, wherein said nanometer-sized particles include TiOx nanometer-sized particles.

14. The method according to claim 11, wherein said sol-gel includes absolute alcohol and ultrapure water in a ratio of about (1:0.025) and a metal oxide including titanium oxide and/or zinc oxide.

15. The method according to claim 14, wherein said metal oxide comprises at least one of inorganic metal salts and metal organic compounds.

16. The method according to claim 15, wherein said metal organic compounds include metal alkoxides comprising at least one of titanium isopropoxide and zinc butoxide.

17. The method according to claim 10, wherein said monomer comprising at least one of oxadiazole, aniline, and pyrrole.

18. The method according to claim 1, wherein said substrate(s) includes a silicon substrate or silicate substrate.

19. The method according to claim 1, wherein said substrate(s) includes a transparent plastic or plastic-like material.

20. The method according to claim 1, wherein said substrate acts as an electrode comprises a coating of at least one transparent metal oxide including SnO_2:F, SnO_2:In (ITO), and Au.

21. The method according to claim 1, wherein said substrate acts as an electrode comprises a coating of at least one transparent metal oxide being conducting polymers including polythiophenes, polypyrroles, polyanilines, and polybutylthiophenes.

22. The method according to claim 1, wherein said conjugated polymer includes pbT dissolved in chlorobenzene.

23. The method according to claim 1, wherein said photoabsorbing material comprises at least one of thermotropic liquid crystalline materials, polybutylthiophene (pbT)/chlorobenzene, and polyelectrolytes.

24. The films surface imprinted with nanometer-sized particles produced by the method of claim 1.

25. Method of making films surface imprinted with nanometer-sized particles to produce micro- and/or nano-structured electron and hole collecting interfaces, comprising:

providing at least one transparent substrate;

providing at least one photoabsorbing conjugated polymer including polybutylthiophene (pbT);

providing a sufficient amount of multiwalled carbon nanotubes (MWNT) to produce a charge separation interface;

providing at least one transparent polymerizable layer including a sol-gel or monomer;

embedding said MWNT in said conjugated polymer (pbT);

applying said polymerizable layer on a first said substrate to form a charge transport film layer;

applying said pbT/MWNT mixture on a second said substrate to form a MWNT bearing surface film layer, wherein said MWNT forms a stamp surface;

imprinting said MWNT stamp surface into the surface of said polymerizable film layer to produce micro- and/or nano-structured electron and hole collecting interfaces;

polymerizing said polymerizable film layer to promote shrinkage to form a conformal gap between said MWNT stamp surface and said surface of said polymerizable film layer; and

filling said gap with at least one photoabsorbing material to promote the generation of photoexcited electrons and transport to the charge separation interface.

26. The method according to claim 25, wherein either said applying process further comprises at least one of processes of spin-coating, dip-coating, spray-coating, flow-coating, doctor blade coating, and screen-printing.

27. The method according to claim 25, wherein said imprinting includes compressing and thereafter, solidifying said MWNT stamp surface into said surface of said polymerizable layer.

28. The method according to claim 25, wherein said substrate acts as an electrode comprises an coating of at least one transparent metal oxide including SnO2:F, SnO_2:In (ITO), and Au.

29. The method according to claim 25, wherein said photoabsorbing material comprises at least one of thermotropic liquid crystalline materials, polybutylthiophene (pbT)/chlorobenzene, and polyelectrolytes.

30. The method according to claim 25, wherein said films being utilized in a photovoltaic device or other light guiding device.

31. Method of making films surface imprinted with nanometer-sized particles to produce micro- and/or nano-structured electron and hole collecting interfaces, comprising:

providing at least one transparent substrate;

providing at least one photoabsorbing conjugated polymer;

providing a sufficient amount of nanometer-sized particles to produce a charge separation interface;

providing at least one transparent polymerizable layer including a polymer;

embedding said nanometer-sized particles in said conjugated polymer;

applying said polymerizable layer on a first said substrate to form a charge transport film layer;

applying said conjugated polymer/nanometer-sized particle mixture on a

second said substrate to form a nanometer-sized particles bearing surface film layer, wherein said nanometer-sized particles form a stamp surface;

imprinting said stamp surface into the surface of said polymerizable film layer to produce micro- and/or nano-structured electron and hole collecting interfaces;

polymerizing said polymerizable film layer to promote shrinkage to form a conformal gap between said stamp surface and said surface of said polymerizable film layer; and

filling said gap with at least one photoabsorbing material to promote the generation of photoexcited electrons and transport to the charge separation interface.

32. The method according to claim 31, wherein said polymer comprising at least one of nitrogen containing heterocycle(s) and polyaniline.